[0079] FIG. **8** illustrates a flight track that is selected from point of closest approach.

[0080] FIG. **9** illustrates a typical NOMS layout where the aircraft tracks are illustrated on a GIS map along with the locations of noise monitors.

[0081] FIG. **10** illustrates the actual recorded noise level at each of the monitors on the GIS map.

[0082] FIG. **11** illustrates a typical noise event for an aircraft as a Single Event Level or "SEL."

[0083] FIG. **12** is a block diagram illustrating the Coastal Defense and Homeland Security, Search and Rescue (Coastal and Mountainous Terrain) and ADS-B Back up and Validation of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0084] FIG. **12** is a block diagram illustrating the Coastal Defense and Homeland Security, Search and Rescue (Coastal and Mountainous Terrain) and ADS-B Back up and Validation of the present invention. In this embodiment there are essentially three channels of data from the aircraft **100** analyzed by the system in real time, one is flight tracking data based on multilateration of aircraft emitted signals **110** including transponder, DME, JTIDS, and various other pulse emitters located on the aircraft. The emitter signals are then time-stamped, either at the sensor **150** or at the central server **250** to perform TDOA analysis and pinpoint the location of the aircraft using multilateration techniques. Similarly, each sensor **150** may detect the aircraft's annunciated position as would be used by Automatic Dependent Surveillance Broadcast (ADS-B). The sensors **150** may be stationary and located on the ground, towers, or at sea on buoys, or they may be dynamic and located on marine vessels, aircraft, or UAVs.

[0085] The other two channels illustrated in this embodiment are noise/audio **400**, **450** and electronic fingerprinting or electronic intelligence **500**, **550**. Other parallel channels may be added including video, infrared, and primary radar. As aircraft **100** approaches a given area, sound (noise) made by aircraft **100** may be detected by microphones, or very low audio frequencies produced by aircraft **100** may be detected by vibration detectors. This noise or sound data may be transferred from the sensor **450** to a processor **300** either digitally or on analog form using a variety of communications media **500**.

[0086] The location of the audio or vibration, as determined by an array of microphones **450** may then associated with the location of the aircraft as determined by multilateration **250**. Furthermore, the characteristics of the audio, such as spectra, may be used to help classify the aircraft type, for example a turbo prop or a jet aircraft. The audio sensors **450** may or may not be located with the aircraft tracking sensors **150** which may include locations that are fixed or dynamic, such as cell towers, on tops of buildings, or at sea on buoys or other vessels.

[0087] Electronic intelligence channel **550** receives all emissions **525** from aircraft **100**, and passes them through data path **600** to processor **300** for identification of the emitter type. Aircraft emitter type may be identified at the sensor **550** or at the processor **300** using a variety of transmission media, including fiber, radio link, analog or digital landline **600**. From this data, electronic fingerprinting can be performed, and this and other intelligence data fused with other data sources in processor **300** to provide a redundant tracking and identification system for aircraft and other vehicles. In addition, such fused data can be used to track aircraft, vessels, and other vehicles for emergency and rescue operations.

[0088] Electronic fingerprinting is the ability to analyze the received signals for source identity in order to associate an estimate of emitter type with aircraft track. The emitter type can then be associated with a specific aircraft type. Thus, receiver **550** in FIG. **12** may comprised, for example, and embodiment of the VERA E system Receiver **550** thus has a capacity of up to 200 automatically tracked targets. Measured signal parameters include are as follows:

[0089] TOA/TDOA: 25 ns resolution

[0090] Pulse width: 0.15-130 us with 25/200 ns resolution

[0091] Carrier frequency: 1 MHz resolution in 1-18 GHz range

[0092] Pulse repetition interval: 25/200 ns resolution

[0093] Pulse amplitude: 3 dB resolution

[0094] The VERA E system can operate with various signal types, including conventional, staggered/jitter PRI, frequency agile, MPRF/HPRF pulse Doppler, intra-pulse modulated (P/FMOP). Pulse analysis may be performed by independent signal analysis channel. An electronic parameter list may be provided with precise measured signal parameters. The system also offers intra-pulse analysis as well as military Mode 1 and Mode 2 target identification.

[0095] By combining these various data source elements, a system may be employed to track vessels, aircraft, and other vehicles for emergency (e.g., vessel in distress) or security purposes. Portable antenna systems such as the VERA-E system may be employed for specific tracking operations. Antennas may also be placed on buoys, such as existing NOAA weather buoys, navigation buoys or dedicated tracking buoys, to provide tracking information and target identification and location.

[0096] In addition, the use of such multiple sources may be employed as a back-up for conventional surveillance radar or ADS tracking systems or the like. Data from the present invention may be fused with such tracking data, and discrepancies noted which may indicate whether underlying tracking data is inaccurate or whether a sensor, sensors, or systems are malfunctioning.

[0097] For example, multilateration sensors **150** receive signals from aircraft **100** indicating the aircraft is small general aviation aircraft (e.g., transponder spoofing) but noise sensors indicate that a large jetliner is in the same location and following the same track, authorities may alerted that a possible terrorist attack is in progress. Alternately, such redundant data could indicate transponder errors, tracking errors or sensor errors, or the like in primary or secondary tracking systems. Electronic fingerprinting and intelligence data from system **550** may be used to similarly verify location and identification of an aircraft or other vehicle or vessel.

[0098] For marine applications, sensors **150**, **450**, and **550** may be located on land, or on buoys or other waterborne locations to provide for better tracking over water. Distress signals and other electronic signals from boats or other vessels may be used to track location of such vessels for search and rescue applications. In addition, other signals (such as cell phone signals and other electrical signals) may be used to track vessels for surveillance purposes (e.g., drug smuggling, illegal immigration, and the like).

[0099] Portable antenna, such as the VERA-E system **550** may be employed for search and rescue operations, for example, to track climbers stuck on a mountain, by detecting